Use of Polythene In Flexible Pavement As An Ingredient

Alpa Singh Chauhan[1], Sonam Jaiswal [2], Shakti Kumar [3], Siddhant Rajput[4]
[1, 2] Dept of Civil Engineering
[3, 4] Assistant Professor, Dept of Civil Engineering
[1, 2, 3, 4] Bansal Institute of Engineering & Technology, Lucknow (UP)

Abstract- *Waste plastic materials such as cups, polythene bags, is increasing day by day leading to the serious environmental hazards as the plastic is non- biodegradable. Thus, this waste needs to be removed from the environment or utilized effectively. It has been seen that the waste plastic materials can improve the desired properties of bituminous mix for repairs and construction of bituminous pavements. The molten plastic can be used to coat the aggregates and also as a partial replacement of bitumen in the bituminous mix. The mix polymer coated aggregate and modified bitumen have shown higher strength. Use of this mix for road construction helps to use plastic waste effectively. Now a day's waste plastic is used in bituminous road construction. This technology is not a new concept but rather not practiced widely.*

Keywords- Plastic Waste, Bitumen, Aggregates, Plastic coated aggregates, Plastic modified bitumen.

I. INTRODUCTION

The use of plastic-coated aggregates has been proposed for disposing plastic wastes. Utilizing reused plastic can enhance the mechanical qualities of flexible pavement and some of the advantages are binding property, stability, density, and high resistance to water in cracks.

Plastic waste replaces 10 % to 12% of bitumen, and thereby save approximately Rs. 30000 to Rs.50000 per kilometer of a road stretch. Shredded plastic waste act as a strong binder agent for making the asphalt.

Plastic is non-biodegradable material, and it has been searched that plastic takes around 4000 years to decay in nature. Plastic Waste is great danger for environment. In 2005, monsoon rains flooded Mumbai, plastic bags were responsible for clogging the underground drainage system.

In 2000, 3000 cows died in Lucknow, the city investigated and find plastic bags in their stomach, which became the causes of death.

In research found that, 300-million-ton plastic waste are occurred in year globally. 3.5-million-ton plastics produce in India every year and 9200 ton produces in every day. Plastic wastes are durable, improper disposal of plastic may cause breast cancer, reproductive problems in humans and animals, genital abnormalities and much more.

Nowadays, we can use plastic in road construction purposes because, durability of plastic is high, and it degrades very slow. The technique for using plastic waste for ecological beneficiation by and for the future age must be derived. To decrease the high rate of waste collection, there are approaches to reuse them in road construction.

Use of higher percentage of plastic waste reduces the need of bitumen 10%. Plastic can also increase strength and performance of the pavement. Plastic increases the melting point of bitumen and hence, missing can be done is better and easier way.

II. LITERATURE REVIEW

The use of plastic waste in flexible pavements would open a solution for the disposal issues regarding plastic wastes. Many research works have been done in the area of the use of plastic waste in bituminous road construction.

Prof. C.E.G. Justo said that addition of 8% by weight of processed plastic for the preparation of modified bitumen

results in a saving of 0.4% bitumen by weight of mix of about 9.6 kg bitumen per cubic meter of bituminous concrete mix.

V.S. Punith (2001) said that there is possibility to improve the performance of bituminous mixture in road pavement. Waste plastics are softened on heating at 130 ^{0}C.

Dr. R. Vasudevan and S. Rajasekaran (2007), said that the polymer bitumen blend is a better binder compared to plain bitumen. Blend has increase softening point and decreased Penetration value with a suitable ductility.

Sabina (2001) studied that the comparative performance of bituminous mixes containing plastic / polymer (PP) with conventional bituminous concrete mixture. Improvement in properties like Marshall Stability, indirect tensile strength.

Sultana (2012), investigation and utilization of waste plastic as a strength modifier in surface course of flexible and rigid pavement. The use of waste plastic modifier for asphalt concrete and cement concrete pavement.

Amit Gawande (2012) - The quantum of plastic waste in municipal solid waste (MSW) is increasing due to increase in population, urbanization, development activities and changes in life style which leading widespread littering on the landscape. Thus, disposal of waste plastic is a menace and become a serious problem globally due to their non-biodegradability and un aesthetic view. Since these are not disposed scientifically & possibility to create ground and water pollution. This waste plastic partially replaced the conventional material to improve desired mechanical characteristics for particular road mix. In conventional road making process bitumen is used as binder. Such bitumen can be modified with waste plastic pieces and bitumen mix is made which can be used as a top layer coat of flexible pavement. This waste plastic modified bitumen mix show better binding property, stability, density and more resistant to water.

III. OBJECTIVES

The main objective of this project is to produce flexible pavement from plastic wastes-

1. To prepare Marshell stability samples with plastic waste and without plastic waste.
2. To coat the aggregates with the waste plastic material.
3. To check the properties of bituminous mix specimen.
4. To prepare statistical model for optimum utilization of plastic waste.
5. To reduce the disposal problem of plastics.

IV. METHOLOGY

There are two processes for making plastic waste bituminous road-

A. WET PROCESS
B. DRY PROCESS

DRY PROCESS

The simplest process to utilize plastic in road construction is by using the “dry-processed” In the dry process, the processed waste plastic is shredded and added to the hot aggregate. The Indian Road Congress (2013) and National Rural Roads Development Agency (2019) indicates that the shredded waste plastic size should preferably be 2-3 mm for better spread and coating on the aggregate. Dust and other impurities should not exceed 1%. The shredded waste plastic is then added to the aggregates that are heated to 170ºC. The shredded waste plastic softens and melts to form a coating around the aggregates. The bitumen is also heated to 160ºC, and the plastic-coated aggregates are then mixed with bitumen and used for road construction

V. LABROTARY TESTS

1. Test on aggregates

1. Aggregate crushing test
2. Water Absorption
3. Impact test

2. Test on bitumen

1. Penetration test
2. Softening point test
3. Viscosity test
4. Marshall Stability test.

VI. DRY PROCESS PROCEDURE

1. Collection of plastic and shedding- Waste plastic is collected from roads, garbage trucks, dumpsites or compost plants, or from school collection programs, or by purchase from rag- pickers or waste-buyers.

Plastic waste which is cleaned is cut into a size between

2.36 mm and 600 microns and of maximum size 2.36 mm length and 2.00 mm width using a shredding machine or (manually).

COLLECTION OF PLASTIC AND SHEDDING

2. Mixing of Shredded Waste Plastic, Aggregate and bitumen- Aggregate and Bitumen were heated at 160 degree Celsius for 24 hours, after that mix them both with plastic at 160 degree Celsius and then put MOULD MACHINE with filter paper on both side and temping 75 times, after the sample is set, we keep it at room temperature for 24 hours.
Mould hammer weight 4.9Kg and mould dia 101mm, height 63.5mm.

Mixing of Plastic, Aggregate and Bitumen

Temping of sample

3. Marshall Stability Test- After keeping the cube at room temperature for 24 hours, we dip it in water for half an hours before doing Marshall stability test, then after we dry it , we use it for strength check.

VII. TEST RESULTS OF MATERIAL

1. TEST RESULT OF AGGREGATE:

Sl. No.	Tests	Results			Specification as per (IRC:105-2019)
		20MM	10MM	06MM	
1	Combined Flakiness & Elongation Index (%)	24	26	-	Max 30%
2	Water Absorption (%)	0.54	0.64	0.95	Max 1%
3	Impact Value (%)	22	18	-	Max 24%
4	Stripping Value (%) (Minimum retained Coating)	97	96	-	>95%

2. TEST RESULT OF BITUMEN:

SN.	CHARACTERISTICS	GREDE (VG30)	TEST METHOD
1	Penetration at 25°c ,0.1 mm, min	45	IS1203
2	Absolute Viscosity at 135°C, min	2400-3600	IS1206 (PART-2)
3	Kinematic viscosity at 135°C, min	350	IS1206 (Part3)
4	Flash Point (COC method), °C, min	220	IS 448 [P:69]
5	Solubility in trichloroethylene, % min	99.0	IS1216
6	Softening point (R&B) temperature, °C, min	47	IS1205
7	Ductility at 25°c, cm, min	40	IS1208

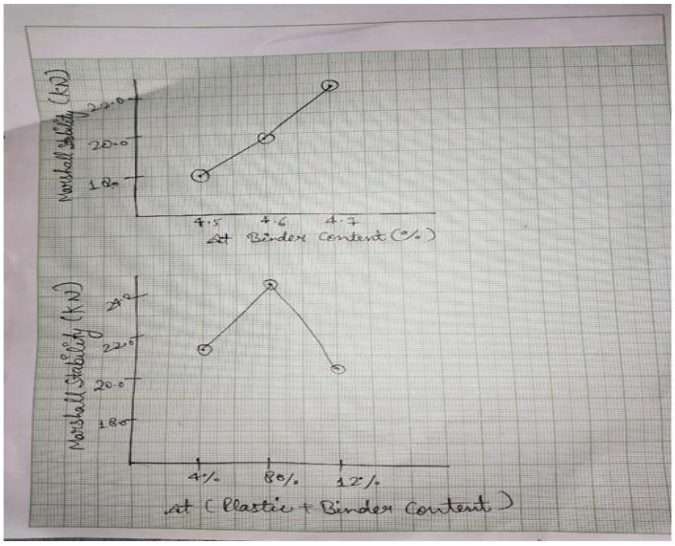
3. SPECIFIC GRAVITY OF INGRIDIENT:

SN.	INGRIDIENTS	SPECIFIC GRAVITY
1	Aggregate (20mm)	2.66
2	Aggregate (10mm)	2.62
3	Aggregate (06mm)	2.64
4	Stone Dust	2.71
5	Bitumen	1.03

SPECIFIC GRAVITY TEST

4. MARSHALL STABILITY TEST:

Sr. No	Binder Content (%)	Density (gm/cc)	Marshall Stability (kN)	Flow (mm)
1.	4.7 %	2.487	22.54	2.9
2.	At(4% Plastic+ Binder Content)	2.380	21.62	2.3
3.	At(8% Plastic+ Binder Content)	2.398	24.25	4.2
4.	At(12% Plastic+ Binder Content)	2.387	20.81	4.5



FLOW CHART OF MARSHELL STABILITY TEST:

VIII. ADVANTAGE

Durability:
Plastic waste can enhance the durability of pavements, making them last longer.

Reduced Maintenance:
Pavements with plastic additives require less maintenance over time.

Environmentally Friendly:
It helps recycle plastic waste, reducing its impact on the environment

Cost Savings:
Using plastic waste can lower construction costs, as it's often cheaper than traditional materials.

Reduced Maintenance:

Pavement with the plastic tend to require less maintenance due to their enhanced durability.

IX. DISADVANTAGES

Environmental concerns:
While it can plastically waste, there may still be environmental concern related to the long - term effects of plastic in the pavement.

Quality control:
Ensuring consistent quality and performance of plastic – based pavement can be challenging.

Limited applications:
Not suitable for all types of pavements or road conditions.

Research needed:
More research is required to fully understand the long-term effects and benefits.

X. FUTURE SCOPE

1. Road accidents due to potholes will be reduced to a Greater extent.
2. Cost of construction will be reduced.
3. Strength of the road increased (increased Marshall Stability value).
4. Better resistance to water and water stagnation.
5. No stripping and have no potholes in the pavement.
6. Increased binding and better bonding of the bitumen mix.
7. Increased load withstanding property of road.

8. Overall consumption of bitumen decreases.
9. Maintenance cost of the road is almost nil.
10. The road life period i substantially increased.
11. No effect of radiation like UV.

XI. CONCLUSION

Using waste plastic in flexible pavements can be promising way to recycle plastic and make roads more durable. It helps reduce plastic pollution and can save money.

We need to keep studying and improving this technique to make sure it is safe for environment and maintenance quality over time. So, while its positive step, we should continue researching and refining the use of waste plastic in pavement for a sustainable future.

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